

Tokamak Experiments-summary, PFC March 2006

1. C-Mod Plasma boundary program

Boronization was found to be a key for high plasma performance. Further studies are needed, including in-situ boronization. C-Mod continued to work on H/D retention and removal studies, disruption mitigation and develop separable divertor particle and heat control functions.

2. D retention studies in C-Mod

Both cleaned and boronized Mo surface can retain large amount of D. Planned disruptions proved to be effective at D recovery “desorption via surface heating”. D retention seems to scale with ion fluence. B is deposited in ~0.5mm tile gaps, with codeposited D. B deposition started from boronization. Found higher D/B ratio ~2 to 10% further down the gap.

3. Final Li experiment on CDX-U and LTX status

e-beam evaporation system works well with 1000 Å coatings in <5 min, and the surface can handle very high power density. ~30% recycling coeff. and record confinement time, exceeds ITER98P(y,1) by 2-4 times, and low loop voltage. CDX-U being converted to LTX. Lithium tokamak could lead to a small CTF ($R_0=1.25\text{m}$, $a=0.75\text{m}$, $\kappa=2$, $B=3\text{T}$, $\beta=40\%$, $P_{\text{fusion}}=400\text{ MW}$, with peak neutron wall loading $\sim 16\text{ MW/m}^2$ and corresponding high heat fluxes.)

4. Edge and boundary topical science area

DIII-D addressing physics issues: PSI group, heat flux control and fuelling, transport & ELMs and AT divertor. Radiative divertor was successfully applied to “Hybrid” operation. 2-D data shows D and C emission mainly from divertor region. Modeling show core plasma is fueled thru divertor x-point or divertor neutral leakage. New lower divertor with raised outboard floor (better match ITER plasma shape) and contoured tiles will operate in May.

5. Observation of Dust in DIII-D during normal plasma operation using Rayleigh/Mie scattering

DIII-D Thomson System was used to detect dust particles in the DIII-D plasma from various sources for over ~700 discharges. P. West found the dust density falls from the wall to separatrix and the estimated particle size ~80nm and with a dust density of $\sim 5 \times 10^{-3}/\text{cm}^3$. These particles seem to disappear to the SOL and do not contaminate the core plasma.

6. Temperature dependence of C erosion/deposition and D codeposition in the DIII-D divertor

For gap experiment, two samples were exposed to ~30 C and 200 C, with total exposure time of about 32s. Net deposition was found on the non-heated sample but not on the heated sample. Deposition in the gap was reduced by a factor of 2-4 was found in the heated sample. The corresponding D co-deposition was also reduced by a factor of 10. Similar results of reduced deposition were found on Mo-mirror exposed to higher temperature. Elevated temperatures mitigates the reflectivity drop but not for the short wavelength range reflectivity.

7. Deposition of ^{13}C from injected methane in L and H-mode plasma in DIII-D

With toroidally symmetric injection of ^{13}C from the top of the DIII-D divertor, the deposition of ^{13}C was measured from the selected tiles. For L-mode discharges, deposition was heaviest near inner divertor, OEDGE and DIVIMP models reproduced the deposition pattern. For H-mode plasma addition deposition was found in the private flux zone, explanation is not clear yet.

8. DIII-D new lower divertor

The design, fabrication and installation of the DIII-D lower divertor was presented. The new divertor has actively cooled channels behind the tiles. The fabrication of the structure was done at ASIPP, China. Tiles on top of the divertor has a tile height alignment of <0.1mm.

9. DiMES and MiMES

Recent experiments are focused on ITPA issues including gap and mirror experiments and surface material erosion and deposition at different temperatures. The MiMES sample changer window has been installed. The DiMES system still needs to be installed this week. Near term focus is on the design and fabrication of the MiMES materials exposure sample and putting the DIMES system together.

10 1-D measurement of edge plasma flows

1-D velocity time-delay-estimation (TDE) method was used and compared with mach probe measurements. The PISCES controlled Shear De-correlation Experiment (CSDX) was used. Similar magnitudes were found from TDE velocities and probes. Still needs to understand the transport implications from the two measurements. Analysis is on-going.

